Thailand Vietnam Socio Economic Panel

Comparing peri-urban versus rural poverty and child malnutrition reduction: Insights from Southeast Asia

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Leibniz Universität Hannover

2017

TVSEP Working Paper

WP-005

Gefördert durch DFG Deutsche Forschungsgemeinschaft

Leibniz Universität Hannover

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

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Comparing Peri-urban versus Rural Poverty and Child Malnutrition Reduction: Insights from Southeast Asia

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Abstract

Success in reducing monetary poverty in Southeast Asia does not fully translate into reduction in malnutrition. Using a three-year panel data from one province each in Thailand, Lao PDR and Vietnam, we study the correlation between monetary poverty and nutritional outcomes of children under five. Furthermore, we analyze differences between nutrition outcomes of children between rural and peri-urban areas. We apply ordinary least squares, two stage least squares and quantile regression models and find that nutrition remains a problem despite achievements in poverty alleviation. Results also show significant differences across countries as well as between peri-urban and rural areas.

Keywords: Poverty, Child malnutrition, Peri-urban, Rural, Southeast Asia

JEL: I15, I30, R11

RePEc:tvs:wpaper:wp-005

1. Introduction

Thailand, Lao PDR and Vietnam have developed rapidly but at different paces. While Thailand has reached the level of an upper-middle income economy, Vietnam and Lao PDR still belong to the lower-middle income group (WB, 2017). However, over the past decades all three countries have been successful in reducing monetary poverty. On the other hand, poverty is a multi-dimensional phenomenon and success in reducing monetary poverty does not equally mean success in cutting down non-monetary poverty. The latter includes education, health, empowerment and nutrition (Sen, 2000; Carter and Barrett 2006). A weak correlation between monetary poverty and nutritional poverty has been found in several empirical researches (e.g. Baulch and Masset, 2003; Haddad et al. 2003, Alderman et al. 2006).

It is well established that nutritional status during early stages of childhood has an impact on the physical, mental and social development of the child later on (UNICEF, 2016). But, evidences show that there are regional differentials of childhood nutritional status in developing countries. Specifically, urban children generally have a better nutritional status than their rural counterparts thanks to favourable socioeconomic conditions (Frankenberg et al., 1998; Garrett and Ruel, 1999; Smith et al., 2005; Fotso, 2007). However, nutritional transitions in the process of economic development in emerging markets especially in peri-urban areas remain unclear.

Hence, this study aims to build this gap in literature by examining the relationship between monetary poverty and nutritional outcomes in three neighboring countries - Thailand, Lao PDR and Vietnam. Furthermore, we examine the rural and peri-urban differentials within provinces in these countries. Results reveal that poverty alleviation does not automatically translate to

nutrition security. We also find the nutritional outcome model that may have a good overall geographic perspective may miss the heterogeneity that exists at the local levels.

The paper proceeds as follows. In the next section, the conceptual framework, which outlines the indicators measuring nutritional outcomes of children and the drivers of childhood nutrition, is presented. Section 3 describes the empirical strategy used in this study. Details of study area and data collection procedure are discussed in section 4. Section 5 reports the results and section 6 concludes with some policy recommendations.

2. Conceptual framework

Nutritional outcomes of children are widely assessed by age and gender standardized anthropometric indicators. The most common anthropometric indices for accessing the nutritional status of children are weight-for-height (WFH), height-for-age (HFA) and weight-for-age (WFA). These indicators are commonly interpreted based on the Z-score classification system. The Z-scores define anthropometric value as a number of standard deviations (SDs) below or above the reference mean or median value of the World Health Organization (WHO) reference population. The prevalence of undernutrition is determined by the cut-off of < -2SD. More specifically, a Z-score cut-off point between -3SD and -2 SD for WFH, HFA and WFA is classified as moderate undernutrition and less than -3 SD as severe undernutrition. The cut-off value greater than +2 SD is considered overweight for WFA (WHO, 2016).

We use the UNICEF (Ruel, 2008; UNICEF, 2013) framework to examine the drivers of malnutrition. The nutritional outcomes of children are determined by a set of immediate, underlying, and basic causes relating to biological, behavioral, and social aspects. Accordingly,

child nutrition depends first and foremost on the food and nutrients that a child takes as well as the child's health condition. These two determinants are placed as the immediate causes of child malnutrition. The framework also highlights the importance of the household's access to food, childcare practices, and water and sanitation services as underlying causes. Moreover, institutions, economic and political context together with environment constitute the basic component of childhood nutrition.

Empirically, the determinants of child nutritional status are investigated by using the household production framework of Becker (1965), and Strauss and Thomas (1995) (as cited in Garrett and Ruel, 1999; Glewwe et al., 2004; Alderman et al., 2005). Accordingly, the household preferences are characterized by a utility function *U* which depends on the consumption of commodities *C*, leisure *L*, and the human capital outcomes *H*:

$$U = f(C, L, H) \tag{1}$$

wherein, a household maximises its utility under budget and time constraints.

3. Empirical strategy

We use a reduced form nutritional function derived from the household production function to determine the nutritional outcomes of children under five (Glewwe et al., 2004; Alderman et al., 2005; Kabubo-Mariara et al., 2006; Waibel and Hohfeld, 2016) as below:

$$N_{it} = f(E_{jt}, C_{it}, M_{it,} H_{jt,}, V_{kt}, \varepsilon_{it}) \tag{2}$$

where *t* stands for the time *(t=2011, 2013, 2014)*, *i, j, k* respectively symbolise child *(i=1, 2,..,1345),* household *(j=1,2,…, 1105)* and village *(k=1,2,.., 215)*. *N* denotes the nutritional outcomes (WFA and HFA Z-scores) of the child. *E* is the household's aggregate consumption

per capita that includes expenditures of households on food, non-food, and housing related consumption in the preceding year. We use consumption rather than income as the indicator of household wealth since consumption data are likely to be more accurate than income data in developing countries (Deaton, 1997; Glewwe et al., 2004). Moreover, consumption reflects long-term income stream and not just the income of the reference period (Haddad et al., 2003; Glewwe et al., 2004). *C* represents a vector of child characteristics such as age, health status and gender. *M* indicates a number of mother characteristics including age, nutritional outcomes, education and migration. *H* denotes household attributes like size, female headship, number of children under five, migration of other household members, access to tap water and sanitation. A vector of village features *V* reflecting the location and the infrastructure are also included in the regression. ε is randomly distributed error term.

As pointed out by Haddad et al., (2003) and Waibel and Hohfeld (2016) aggregate consumption variable might be endogenous due to the allocation of time constraints between labour supply for expenditure generating activities and child care affecting the nutritional outcomes. Hence, we begin the estimation with ordinary least squares (OLS) and then follow it up with an instrumental variable regression using two-stage least squares (2SLS). We use value of assets per capita as the instrument in the 2SLS regression. The validity of the instrument is tested by an F-test. The differences between OLS and 2SL estimates are tested by a Durbin-Wu-Hausman test.

Beside the estimation of conditional mean effect, we also investigate the effect of covariates on nutritional outcomes at different points of the distribution by using a quantile regression to see if the determinants vary across the distribution. We use the conditional quantile regression estimators proposed by Koenker and Bassett (1978). In our data, the error term might be non-

independent and not identically distributed; we therefore take robust standard errors for OLS and 2SLS regressions and bootstrap standard errors for quantile regressions (Aturupane et al., 2008).

4. Study Regions and Data

We include three provinces in this study, namely Ubon Ratchathani in Thailand, Savannakhet in Lao PDR and Thua Thien Hue in Vietnam. All three provinces are geographically close and can be treated as an economic corridor (ADB, 2010). The three provinces are predominantly agricultural areas, albeit with quite different levels of development. Ubon Ratchathani is the most advanced province with well-developed road networks and good accessibility to markets and public services. The province can thus be labeled as peri-urban. Savannakhet is rather heterogeneous with advanced development in the western part of the province, adjacent to the Mekong River bordering Thailand. This region is similar to Ubon Ratchathani and therefore can also be considered as peri-urban. Contrary to this, in the central and eastern parts of Savannakhet which border Vietnam, infrastructure is poor and therefore these areas can be considered as rural. In terms of development, Thua Thien Hue can be placed between Ubon Ratchathani and Savannakhet. The province has well-developed coastal and lowland parts which show peri-urban characteristics and an upland zone bordering Laos PDR which is clearly rural.

The data used in this analysis for Thailand and Vietnam are part of a research project called "Thailand-Vietnam Socioeconomic Panel" (see https://www.tvsep.de). For Laos the panel data were collected as part of a research project on Food Security in Savannakhet (Laos). The surveys were conducted in different time periods. For Ubon Ratchathani and Thua Thien Hue, it took place in 2011 and 2013 while in Savannakhet it was conducted in 2013 and 2014. The total

number households in the panel in the three provinces are around 2200. However due to the objective we only included households with children under the age of five. Hence our data base includes 1105 households with 1345 children under five from three provinces in three countries.

The sampling procedure differs for the three provinces due to the variation in the agro-ecological and institutional conditions (Hardeweg et al., 2013). Based on the respective country's administrative system, a three-stage sampling method was applied in Thailand and Vietnam while in Lao PDR a two-stage method was used (Parvathi and Nguyen, 2018). Furthermore, in Thailand, Ubon Ratchathani province was treated as a constituted stratum with approximately proportional sample size. In the first stage, sub-districts as the primary sampling unit were selected with probability proportional to the population size. In the second stage, two villages were randomly chosen from each sampled sub-district with the probability proportional to the size of the population. In the third stage, 10 households from each sampled village were selected systematically from a list of households ordered by household size with equal selection probability. This sampling method makes Ubon Ratchathani a self-weighted sample. Thua Thien Hue province is characterised with diverse topography. Hence three strata symbolizing three agro-ecological areas, namely coastal, lowland, and upland were specified in the first stage. The sampling procedure in each stratum of this province was similar to that in Ubon Ratchathani.

In the absence of a well-defined administrative structure in Laos, villages were used as the primary sampling unit. In the first stage, villages within the strata region were sampled. The probability of a village being chosen was proportional to its size. In the second stage the cluster size of 15 households per village in the Mekong and lowland regions while 10 households per

village in the mountainous region were applied. Households were then selected randomly from the village lists.

In the surveys, comprehensive questionnaires were used consisting of several modules such as household members, health status, housing and sanitary conditions, assets, consumption expenditures and income generating activities, especially from agriculture and natural resources. The data on nutrition outcomes for children under five include age, gender, height, weight as well as health conditions. Information on infrastructure conditions at village level was taken from a village head questionnaires which had been carried out in parallel to the household surveys.

5. Results

5.1 Descriptive statistics

The poverty prevalence in provinces Ubon Ratchathani, Thua Thien Hue and Savannakhet is shown by means of a cumulative distribution of per capita consumption with the poverty line of $1.25 (Figure 1a). We pooled data from 2011 and 2013 for Ubon Ratchathani and Thua Thien Hue and data from 2013 and 2014 for Savannakhet. The consumption ranking can be seen clearly in figure 1a whereby the Thua Thien Hue distribution curve (red) is on the left side of the Ubon Ratchathani curve (green) and the Savannakhet curve (blue) is even further left. Noticeably, the position of these curves holds for every point along the distribution of consumption per capita except the crossing point between Thua Thien Hue and Savannakhet at nearly eight dollar per person per day. These distributions imply that among three provinces Ubon Ratchathani has the highest consumption level while Savannakhet has the lowest.

The differences in consumption among areas within province Thua Thien Hue and Savannakhet are shown in Figure 1b. We find the big gaps between peri-urban and rural areas either in Thua Thien Hue or Savannakhet. Another finding is that both rural and peri-urban regions in Thua Thien Hue did better than the respective peri-urban area in Savannakhet province. From the middle part of the distribution in Thua Thien Hue there is a convergence tendency between the two peri-urban and rural areas. This implies that the share of very rich households in the peri-urban area is not significantly different from the shares in the rural areas in this province. This trend is, however, not found in Savannakhet. Therefore, we can say that inequality in consumption is lower in Thua Thien Hue than in Savannakhet. Furthermore, it is striking to notice that the peri-urban areas in Thua Thien Hue and Savannakhet almost converge at higher levels of income indicating that the peri-urban areas are more similar in Laos and Vietnam.

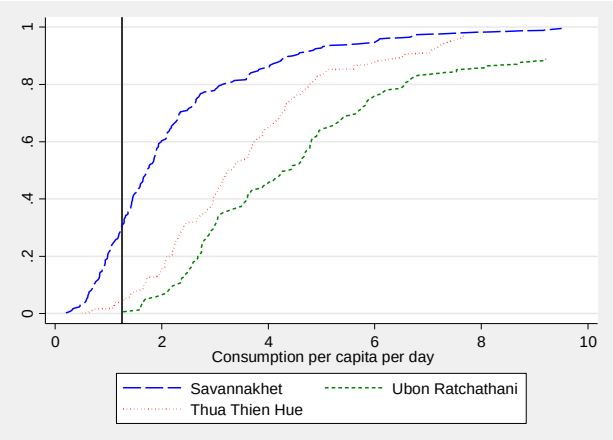


Figure 1a: Province-wise

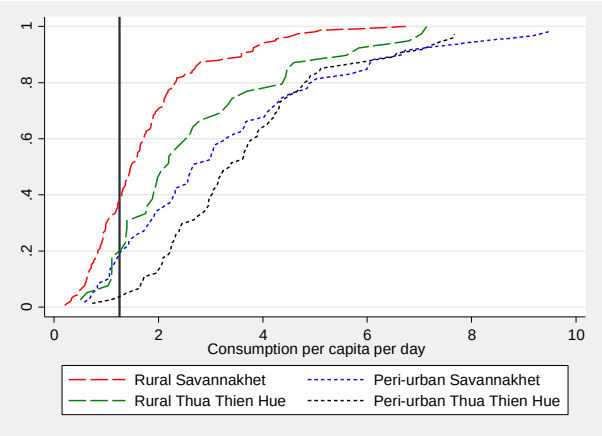


Figure 1b: Area-wise in Savannakhet and Thua Thien Hue

Figure 1: Cumulative distribution of consumption per capita per day
Source: Own calculations based on household survey 2011, 2013, 2014

The second major issue of our study concerns the nutritional outcomes of children less than five years in the three provinces in Thailand, Lao PDR and Vietnam (Table 1). Comparing the nutritional outcomes among three provinces, the malnutrition rate, as expected, is found to be the

lowest in Ubon Ratchathani. Specifically, with 10% underweight, this province can be regarded to have low underweight prevalence according to the WHO classification (WHO, 2010). With values larger than 20 per cent, Savannakhet and Thua Thien Hue are classified as regions with high prevalence of underweight. With regard to stunting, all three provinces are characterised by very high prevalence rates although Ubon Ratchathani has the lowest ratio with 42.11 per cent while Savannakhet has the highest ratio with 59.19 per cent. With reference to wasting, although there is no significant difference among the three provinces, all of them experienced serious wasting pervasiveness in children under five.

Table 1: Child under nutrition by province and area (%)

Province/Area	Underweight (WFA)	Stunting (HFA)	Wasting (WFH)
Ubon Ratchathani (Peri-urban)	9.83[a,b]	42.11[a,b]	13.27
Savannakhet	22.57[a,c]	59.19[a,c]	14.24
Peri-urban	19.85[d]	56.62	13.24
Rural	23.66[d]	60.21	14.64
Thua Thien Hue	28.40[b,c]	58.10[b,c]	14.33
Peri-urban	27.38[e]	58.02	14.04
Rural	41.02[e]	58.97	17.95

Notes: The comparison is made by Pearson's chi-squared test, [a]$p<0.01$ for differences between Ubon Ratchathani and Savannakhet; [b]$p<0.01$ for differences between Ubon Ratchathani and Thua Thien Hue; [c]$p<0.05$ for differences between Savannakhet and Thua Thien Hue; [d]$p<0.1$for differences between peri-urban and rural in Savannakhet; [e]$p<0.1$for differences between peri-urban and rural in Thua Thien Hue
Source: Own calculations based on household survey 2011, 2013, 2014

We examine the peri-urban and rural gap by investigating the anthropometric indicators in these two areas separately. The area-wise comparison shows that nutritional status of children in peri-urban is better than that in the rural area especially in underweight and stunting indicators. With reference to stunting and wasting, no significant gap is observed. These findings are further depicted in the distribution of WFA Z-scores and HFA Z-scores with the cut-off of -2SD in Figure 2a and 2b. Although the gaps of WFA Z-scores between peri-urban and rural areas both

in Savannakhet and Thua Thien Hue are larger than those of HFA Z-scores, WFA gaps are smaller than the gaps found in Figure 1b. This suggests that the big gaps in consumption do not translate into big gaps in nutritional outcomes of children.

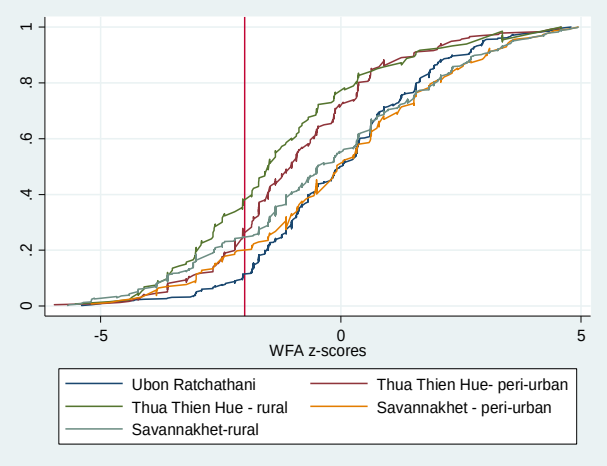


Figure 2a: Weight-for-age Z-scores

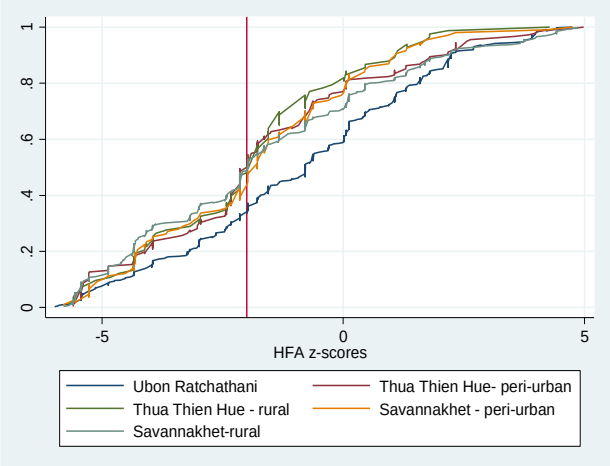
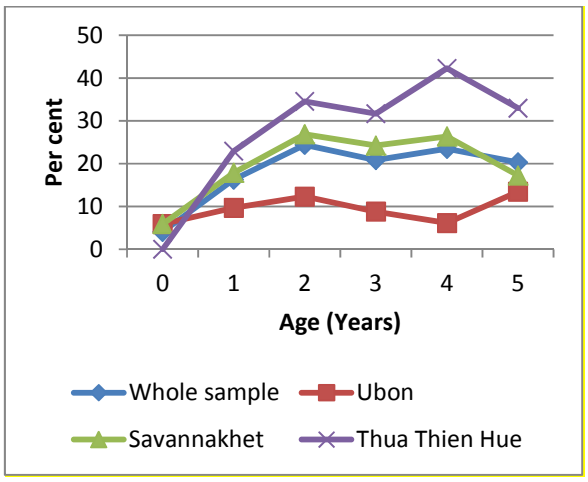


Figure 2b: Height-for-age Z-scores

Figure 2: Cumulative distribution of child anthropometric Z-scores
Source: Own calculations based on household survey 2011, 2013, 2014

We also investigate child nutrition by age at the province level. The results for the underweight in Figure 3a demonstrate a similarity among all three provinces where children below one year are the least likely to be underweight. This could be because they are largely dependent on breast feeding and mother´s nutritional inputs. We do not find much variation in Ubon Ratchathani in the incidence of child underweight among different ages. In this province, the underweight rate fluctuates from around 6 per cent for the age less than one until more than 13 per cent for the age of five. In contrast we find that Savannakhet and Thua Thien Hue show a considerable increasing trend of underweight children from birth to the age of two. Afterwards, the weight-for-age Z-scores improve slightly until children reach the age five. In Thua Thien Hue we find, however,

an increase of underweight prevalence again for the age of four. The distribution for the whole sample shows a similar trend to Savannakhet.



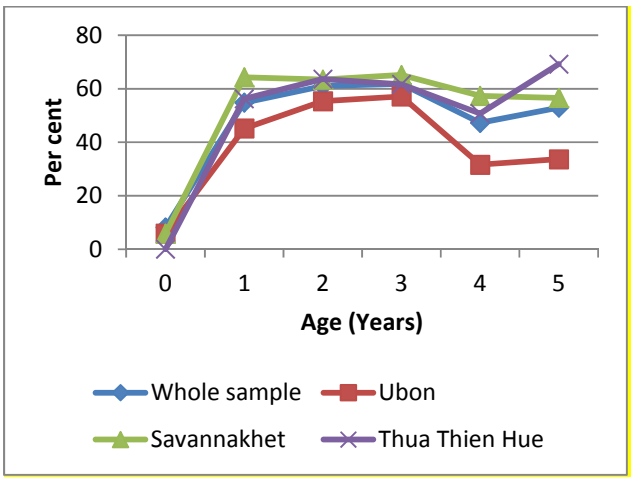


Figure 3a: Child underweight **Figure 3b: Child stunting**

Figure 3: Child undernutrition by age

Source: Own calculations based on household survey 2011, 2013, 2014

Regarding stunting, Figure 3b shows similar shapes for all three provinces across the ages except for the peak at age five for Thua Thien Hue province. Similar to the underweight, the stunting in these provinces shows to be the least common for the age below one year. For the children from one to three years, the stunting incidence rises dramatically. For example, in Ubon Ratchathani the stunting rate was about 45 per cent for age one and peaked with approximately 57 per cent at age three. In Savannakhet, the stunting rates are even higher, around 64 per cent. The prevalence in Thua Thien Hue ranges from around 56 per cent to more than 63 per cent for the age interval from one to three. By the age of four and five, the stunting rates improve in all three provinces except for the case of five years in Thua Thien Hue.

We further investigate the nutritional outcomes of children by classifying them into moderate and severe malnourishment based on the threshold of –2 SD and -3 SD below the median of the WHO child growth standards (Table 2). The peri-urban and rural differences are compared by means of Pearson's chi-squared tests. Surprisingly, regardless of child malnutrition indicators - underweight, stunting, or wasting, and areas- peri-urban or rural; the severe undernutrition rates are much higher than the moderate undernutrition rates (except the underweight in the peri-urban). The gap is extremely large in stunting, especially in the rural area. Table 2 also shows that there is no statistically significant difference across peri-urban and rural areas in terms of moderate undernutrition.

Table 2: Child undernutrition severity by area (%)

Indicator	**Moderate**			**Severe**		
	Rural	Peri-urban	Difference	Rural	Peri-urban	Difference
Stunting (HFA)	9.94	11.74	-1.80	49.91	37.25	12.66***
	(29.95)	(32.21)		(50.04)	(48.37)	
Underweight (WFA)	9.04	9.60	-0.56	17.72	6.82	10.90***
	(28.70)	(29.47)		(38.22)	(25.22)	
Wasting (WFH)	4.88	5.68	-0.80	10.12	7.83	2.29
	(21.60	(23.16)		(30.20)	(26.88)	

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ of Pearson's chi-squared test, standard deviation in parentheses
Source*:* Own calculations based on household survey 2011, 2013, 2014

The relationship between undernutrition and wealth status of households are illustrated in Table 3. The wealth status is expressed by household aggregate consumption. We divided households into five quintiles of consumption by province. As expected, children from wealthier households are less likely to be either underweight or stunted. This trend is consistent in Ubon Ratchathani and Thua Thien Hue. Also in Thua Thien Hue, children living in the poorest consumption quintile are more than twice as likely to be underweight and one point five times more stunted

compared to children residing in the richest quintile. However, unlike underweight and stunting, wasting does not show any clear trend among the wealth status.

Table 3: Child undernutrition by consumption quintile (%)

Province	Consumption quintile				
	1st	2nd	3rd	4th	5th
Ubon Ratchathani					
Underweight (WFA)	11.24	10.47	8.99	9.30	9.20
Stunting (HFA)	52.81	41.86	38.20	47.67	29.89
Wasting (WFH)	10.11	13.95	16.85	5.81	19.54
Savannakhet					
Underweight (WFA)	30.23	20.54	19.82	22.02	17.11
Stunting (HFA)	63.57	66.07	49.55	57.80	58.56
Wasting (WFH)	12.40	10.71	22.52	10.09	14.41
Thua Thien Hue					
Underweight (WFA)	40.38	33.33	33.90	24.07	21.43
Stunting (HFA)	64.42	66.67	59.32	51.85	42.86
Wasting (WFH)	18.30	14.29	11.86	11.11	19.64

Source: Own calculations based on household survey 2011, 2013, 2014

In the next step we investigate the differences in the socioeconomic and demographic characteristics of the households between peri-urban and rural areas. The results show substantial differences across peri-urban and rural households. Peri-urban households are more dependent on off-arm activities to generate income while rural households are agrarian dependent. Peri-urban children are less likely to get sick. This could be because mothers in peri-urban areas are significantly more educated than their rural counterparts. Also the children living in peri-urban areas having educated mothers are more likely to have access to vaccination facilities than rural children. Also peri-urban mothers are older and tend to migrate more.

We also find that the women in peri-urban areas seem to have more intra-household decision-making power than the rural women. Specifically, in peri-urban area around 23 per cent of households are headed by women compared to only 9 per cent in rural area. Peri-urban

household incline towards nuclear families, have better sanitary conditions and are generally wealthier.

Table 4: Comparison of characteristics between peri-urban and rural households

	Rural	Peri-urban	Difference
Income and consumption			
Share of agricultural income (%)	40.43	30.00	10.43 ***
	(35.19)	(32.37)	
Share of natural resource income (%)	27.51	9.63	17.88***
	(32.98)	(25.35)	
Consumption per capita per month (PPP$)	65.40	127.62	-62.22***
	(45.94)	(102.30)	
Food consumption per capita and month (PPP$)	42.22	65.67	-20.45***
	(28.68)	(41.28)	
Household engaged in small business (%)	13.78	41.22	-27.44***
	(34.51)	(49.26)	
Child			
Child is sick (%)	10.92	7.60	3.32*
	(31.23)	(26.52)	
Mother			
Age of mother (Years)	30.43	32.73	-2.3***
	(6.80)	(6.90)	
Height of mother (cm)	151.71	156.34	-4.63***
	(6.20)	(6.15)	
Education of mother (School years)	2.92	6.65	-3.73***
	(3.90)	(4.66)	
Mother migrated (%)	6.52	18.71	-12.19***
	(24.72)	(39.04)	
Household			
Household head is female (%)	9.02	23.25	-14.23***
	(28.69)	(42.27)	
Household size	6.42	5.57	0.85***
	(2.43)	(1.99)	
Dependency ratio (%)	118.59	89.15	29.44***
	(75.81)	(73.70)	
Migration of other members (Days)	139.72	282.18	-142.46***
	(247.95)	(284.46)	
Flush toilet (%)	5.46	22.95	-17.49***
	(22.75)	(42.08)	
Tap water (%)	25.18	54.82	-29.64***
	(43.45)	(49.80)	
Value of assets per capita (PPP$)	516.83	1,666.92	-1150.09***

	(741.97)	(2,982.00)	
Land per capita (ha)	0.10	0.36	-0.26***
	(0.30)	(0.47)	
Village			
Time to reach the next hospital (Minutes)	95.75	26.07	69.68**
	(153.95)	(13.90)	
Village with sanitation (%)	0.00	9.0	-9.06***
	(0.00)	(28.73)	
Village with public water (%)	31.12	77.19	-46.07
	(46.35)	(41.99)	

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t-test and Pearson's chi-square test are used for the comparison of continuous and dichotomous variables, respectively, standard deviation in parentheses
***Source**:* Own calculations based on household survey 2011, 2013, 2014

5.2. Econometric analysis

We investigate the determinants for nutritional outcomes of children under age five using OLS and 2SLS. We estimate the determinants for weight-for-age Z-scores and height-for-age Z-scores of children separately but follow the same approach. In this section, we report the estimation results for weight-for-age Z-scores as weight-for-age is commonly considered as a general indicator of the nutritional status of populations (WHO, 1995; Alderman, 2000; Haddad et al., 2003). The results for height-for-age Z-scores are found in the Appendix Tables A1, A2 and A3. We model regressions at both pooled and province level.

In Thua Thien Hue province, the ethnic minorities account for around 25 per cent of the total province population. The minorities mostly live in two mountainous districts, namely A Luoi and Nam Dong with unfavorable infrastructure condition and higher poverty rates. Therefore, we replace the variable “Mountainous” by dummy variable “Ethnic minorities” in Thua Thien Hue regression. In Savannakhet, there is no public sanitation. The 2SLS estimates are reported next to the OLS estimates for all four regressions in the result table. We take only 901 out of 1345

children under five into the estimation since 444 observations do not have a complete vector of regressors.

Table 5 shows that the results of OLS and 2SLS are quite consistent although there are small differences in the magnitude of the coefficients and standard errors. Conforming to the descriptive results, the monetary wealth of households positively influences the WFA Z-score of children. However, the impact is consistently small and not statistically significant except in the OLS regression of Thua Thien Hue. The weak correlation between consumption expenditures with nutritional outcomes is in line with previous studies (among others, Haddad et al., 2003; Glewwe et al., 2004; Waibel and Hohfeld, 2016). The coefficients of age and age squared show that as children grow older it is possible for them to improve their weight with adequate nutrition. This result is consistent with the descriptive results in Figure 3a and similar to the findings in study of Glewwe et al. (2004) in Vietnam and Kabubo-Mariara et al. (2006) in Kenya. The health condition of the child significantly influences his or her nutritional status (except for Savannakhet). Also, on average a sick child has WFA Z-score around one point less than the score of a healthy child. The statistically negative correlation of the sickness in the previous period of the child with the nutritional outcomes is supported by the nutrition framework of UNCEF (2013).

Contrary to many studies (for example, Sahn and Alderman, 1997; Kabubo-Mariara et al., 2006; Belitz et al., 2010), there are no gender bias in the nutritional status in this study. Nevertheless, Glewwe et al. (2004) also did not find any correlation between the child gender and malnutrition status in Vietnam. The results for the whole sample of both OLS and 2SLS show significant correlation between mother's height and her child's nutritional outcomes though the magnitudes

are small. This result is in line with previous studies implying that the nutritional status of the child is influenced by mother's nutritional outcomes (Glewwe et al., 2004; Alderman et al., 2005; Kabubo-Mariara et al., 2006; Waibel and Hohfeld, 2016).

Regarding other household features, the female headship turns out to be important in determining the outcome of nutrition of children in Savannakhet and especially in Thua Thien Hue. Specifically, the child weight-for-age Z-score tends to be better off if the child lives in a female-headed household. The evidence for this relationship is also found in other studies (Onyango et al., 1994; Rogers, 1996; Chindime and Ubomba-Jaswa, 2007). The argumentation by Rogers (1996) in a study on Dominican Republic for this positive correlation is that the consumption preferences and intra-household food allocation of female-headed households favor child welfare. The domestic sanitation and water source do not show any significant effect on the child weight-for-age Z-scores.

The statistically insignificant village characteristics imply that the village conditions seem not to have impact on the children residing in that community. The province dummies show that children in Thua Thien Hue province in Vietnam ceteris paribus have worse WFA Z-scores than their counterparts in Ubon Ratchathani in Thailand and Savannakhet in Lao PDR. Looking at the year dummy, we do not find time effect in Ubon Ratchathani but surprisingly backward effects in both Savannakhet and Thua Thien Hue.

Table 5: Determinants of child nutritional outcomes by OLS and 2SLS regressions

Dependent variable: WFA Z-scores	Pooled		Ubon Ratchathani		Savannakhet		Thua Thien Hue	
Independent variables	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Household wealth								
Log of per capita consumption (PPP$)	0.12	0.22	0.25	0.13	0.30	0.64	0.38**	0.52
	(1.01)	(0.76)	(1.22)	(0.13)	(1.37)	(1.46)	(1.98)	(1.36)
Child								
Age (Years)	-0.73***	-0.72***	-0.47	-0.48	-0.80**	-0.84**	-1.37***	-1.37***
	(-3.46)	(-3.47)	(-1.47)	(-1.51)	(-2.26)	(-2.43)	(-3.77)	(-3.96)
Age squared	0.09***	0.09***	0.06	0.06	0.10*	0.10*	0.16***	0.16***
	(2.72)	(2.72)	(1.12)	(1.16)	(1.75)	(1.89)	(2.78)	(2.91)
Sick (Yes/No)	-1.06***	-1.05***	-0.98**	-0.99**	-1.16	-1.06	-0.74**	-0.74**
	(-3.92)	(-3.94)	(-2.36)	(-2.48)	(-1.58)	(-1.43)	(-2.07)	(-2.15)
Girl (Yes/No)	-0.03	-0.03	-0.05	-0.06	0.05	0.06	-0.08	-0.09
	(-0.23)	(-0.21)	(-0.23)	(-0.27)	(0.21)	(0.24)	(-0.38)	(-0.46)
Mother								
Age (Years)	0.10	0.10	0.18	0.17	0.13	0.14	0.08	0.07
	(1.18)	(1.17)	(1.31)	(1.26)	(0.98)	(1.06)	(0.47)	(0.40)
Age squared	-0.001	-0.001	-0.003	-0.003	-0.002	-0.002	-0.001	-0.000
	(-1.07)	(-1.07)	(-1.28)	(-1.20)	(-0.84)	(-0.90)	(-0.21)	(-0.12)
Height (cm)	0.03**	0.02**	0.03	0.03	0.03	0.02	0.03	0.03
	(2.11)	(2.01)	(1.45)	(1.55)	(1.34)	(1.03)	(1.23)	(1.28)
Education (School years)	-0.004	-0.01	0.01	0.02	-0.03	-0.04	-0.05	-0.05
	(-0.24)	(-0.36)	(0.56)	(0.46)	(-0.74)	(-1.05)	(-1.47)	(-1.57)
Migrated (Yes/No)	0.23	0.25	0.12	0.12	0.19	0.22	-0.40	-0.40
	(0.97)	(1.03)	(0.35)	(0.37)	(0.44)	(0.51)	(-1.16)	(-1.21)
Household								
Size	-0.000	0.01	0.11	0.10	-0.03	-0.01	-0.10	-0.09
	(-0.01)	(0.20)	(1.23)	(0.59)	(-0.54)	(-0.27)	(-1.31)	(-1.15)
Female headship (Yes/No)	0.33*	0.33*	0.11	0.13	0.94*	0.88*	1.07***	1.11***
	(1.90)	(1.87)	(0.51)	(0.56)	(1.96)	(1.89)	(3.17)	(3.38)
Number of children under five	-0.04	-0.04	0.04	0.04	-0.01	0.000	-0.17	-0.16
	(-0.72)	(-0.65)	(0.27)	(0.28)	(-0.13)	(0.00)	(-1.55)	(-1.47)

Migration of other members (Days)	-0.06	-0.06	0.05	0.05	-0.19*	-0.20*	-0.11	-0.12
	(-1.21)	(-1.28)	(0.70)	(0.71)	(-1.69)	(-1.78)	(-1.50)	(-1.64)
Flush toilet (Yes/No)	0.11	0.07	-0.09	-0.06	-0.04	-0.08	-0.003	-0.06
	(0.47)	(0.28)	(-0.13)	(-0.07)	(-0.06)	(-0.15)	(-0.01)	(-0.20)
Tap water (Yes/No)	0.18	0.17	0.38	0.38*	0.22	0.04	-0.36	-0.38
	(1.13)	(0.98)	(1.65)	(1.72)	(0.61)	(0.08)	(-1.38)	(-1.49)
Village								
Distance to town (km)	-0.002	-0.001	-0.01	-0.01	0.003	0.003	-0.01	-0.01
	(-0.38)	(-0.32)	(-1.03)	(-1.05)	(0.56)	(0.61)	(-0.94)	(-0.86)
Public sanitation (Yes/No)	-0.07	-0.07	0.29	0.31	-	-	-0.19	-0.16
	(-0.20)	(-0.21)	(0.55)	(0.60)			(-0.44)	(-0.39)
Public water (Yes/No)	-0.16	-0.16	0.07	0.04	-0.42	-0.49*	0.06	0.05
	(-0.90)	(-0.95)	(0.15)	(0.10)	(-1.45)	(-1.65)	(0.22)	(0.21)
Mountainous (Yes/No)	0.17	0.17	0.28	0.30	0.01	0.12		
	(0.62)	(0.65)	(0.50)	(0.53)	(0.02)	(0.22)		
Province dummies								
Ubon Ratchathani	1.12***	1.07***						
	(4.43)	(3.82)						
Savannakhet	1.21***	1.19***						
	(4.52)	(4.43)						
Others								
Year 2013			0.28	0.30	0.77***	0.90***	-0.47*	-0.50**
			(1.01)	(1.03)	(3.13)	(3.19)	(-1.87)	(-1.96)
Ethnic minorities							-0.20	-0.12
							(-0.58)	(-0.31)
Intercept	-5.92***	-6.21***	-8.39**	-7.79	-6.70*	-7.44**	-5.19	-5.58
	(-2.63)	(-2.65)	(-2.27)	(-1.10)	(-1.88)	(-2.13)	(-1.00)	(-1.12)
N	901	901	241	241	408	408	252	252
R-squared	0.10	0.10	0.11	0.11	0.09	0.08	0.28	0.28
Hausman test	p=0.42		p=0.92		p=0.37		p=0.69	

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in OLS regression and z statistics in 2SLS regression in parentheses, [a]only children with a complete vector of explanatory variables are included in the regression

Source: Own calculations based on household survey 2011, 2013, 2014

In order to see if the determinants of child nutritional outcomes differ between the peri-urban and the rural areas, we run the regressions separately for these two areas as depicted in Table 6. As Ubon Ratchathani in Thailand has higher development level and is considered as homogenously peri-urban we do not include this province in our regression. We only compare peri-urban and rural areas of Savannakhet in Lao PDR and Thua Thien Hue in Vietnam.

It is striking to note that the impact of the wealth of household on the child WFA Z-scores is significant in the peri-urban but not significant in the rural. This might be due to the fact that the peri-urban households have smaller household size (as shown in Table 4) and normally have weaker social and extended family networks compared to their rural counterparts. As a consequence, peri-urban households rely on their income more than rural households for childcare service. The effects of smaller household size and the potential weaker social and extended family networks of the peri-urban household on its child nutritional outcomes seem to arise again in the coefficient of the number of children under five within one household. It can be explained that the more number of children under five a household has, the less care and resource the child is likely to get given the household's budget and child caretaker constraints. Thus, amount of children aged less than five years residing in peri-urban household is found to have significantly negative impact on the child nutritional status.

Other major difference in the nutrition drivers between the two areas is the migration of household members excluding mother. In peri-urban areas, ceteris paribus, the longer the migration duration of other members, the worse the nutritional status of children under five. The absence of other household members might lessen the caregiving of children. Also it is striking to note that more educated mothers in peri-urban areas have children with lower Z-scores. This

could be because peri-urban educated mother (as shown in Table 4) are more likely to engage in income-generating activities outside the home. Consequently, the time that she spends on childcare might be reduced due to time constraints.

The peri-urban and rural comparison also show that the age effect on child nutritional outcomes is significant in the rural but not in the peri-urban area. Furthermore, the coefficients of the mother's height suggest that the mother's nutritional status matters more in the rural area than in the peri-urban area. This is consistent with the lower value of height of rural mother compared to peri-urban mothers found in Table 4.

The significant and similar determinant for both peri-urban and rural child WFA Z-scores is the female household headship which is also found highly significant in the province regressions. This finding implies that the intra-household decision-making power of women really matters both in peri-urban and rural areas in Savannakhet and Thua Thien Hue. To sum up, the findings in Table 6 suggest that determinants of child nutritional outcomes are quite different across peri-urban and rural households.

Table 6: Determinants of child nutritional outcomes in peri-urban and rural areas

Dependent variable: WFA Z-scores	**Peri-urban**		**Rural**	
Independent variables	OLS	2SLS	OLS	2SLS
Household wealth				
Log of per capita consumption (PPP$)	0.51**	0.87**	-0.11	0.36
	(2.51)	(2.07)	(-0.52)	(0.75)
Child				
Age (Years)	-0.59	-0.52	-0.97***	-1.03***
	(-1.41)	(-1.24)	(-2.63)	(-2.84)
Age squared	0.05	0.04	0.12**	0.13**
	(0.79)	(0.62)	(2.04)	(2.21)
Sick (Yes/No)	-1.29**	-1.32**	-0.94*	-0.84
	(-2.00)	(-2.15)	(-1.77)	(-1.46)
Girl (Yes/No)	0.17	0.15	-0.14	-0.13
	(0.74)	(0.68)	(-0.55)	(-0.51)

Mother				
Age (Years)	0.10	0.04	0.13	0.13
	(0.53)	(0.22)	(0.80)	(0.80)
Age squared	-0.001	0.000	-0.002	-0.002
	(-0.26)	(0.05)	(-0.75)	(-0.73)
Height (cm)	-0.003	-0.004	0.04**	0.04*
	(-0.13)	(-0.19)	(2.07)	(1.68)
Education (School years)	-0.09**	-0.10***	-0.01	-0.03
	(-2.60)	(-2.91)	(-0.32)	(-0.64)
Migrated (Yes/No)	0.43	0.49	-0.50	-0.49
	(1.02)	(1.17)	(-1.50)	(-1.50)
Household				
Size	0.04	0.08	-0.10*	-0.08
	(0.37)	(0.67)	(-1.78)	(-1.43)
Female headship (Yes/No)	0.97**	0.98***	1.06**	0.98**
	(2.39)	(2.58)	(2.11)	(1.97)
Number of children under five	-0.28**	-0.29**	-0.11	-0.09
	(-2.10)	(-2.24)	(-1.17)	(-1.05)
Migration of other members (Days)	-0.18**	-0.20***	-0.10	-0.12
	(-2.20)	(-2.60)	(-0.77)	(-0.89)
Flush toilet (Yes/No)	0.29	0.17	0.06	-0.10
	(1.06)	(0.60)	(0.15)	(-0.24)
Tap water (Yes/No)	-0.31	-0.40	0.28	0.03
	(-0.95)	(-1.22)	(0.72)	(0.06)
Village				
Distance to town (km)	-0.002	-0.002	0.000	0.000
	(-0.12)	(-0.19)	(0.04)	(0.04)
Public sanitation (Yes/No)	0.02	0.06	-	-
	(0.04)	(0.14)		
Public water (Yes/No)	0.02	0.04	-0.27	-0.38
	(0.06)	(0.17)	(-0.85)	(-1.17)
Mountainous (Yes/No)	0.51	0.51	-0.16	-0.02
	(0.84)	(0.90)	(-0.28)	(-0.04)
Province dummy				
Savannakhet	0.92**	0.82**	1.34**	1.26*
	(2.28)	(2.09)	(1.98)	(1.88)
Intercept	-3.18	-3.75	-6.89*	-7.66*
	(-0.66)	(-0.82)	(-1.70)	(-1.93)
N[a]	229	229	431	431
R-squared	0.21	0.21	0.10	0.09
Hausman test	p=0.38		p=0.32	

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in OLS regression and z statistics in 2SLS regression in parentheses, [a]only children with a complete vector of explanatory variables are included in the regression
Source: Own calculations based on household survey 2011, 2013, 2014

In the next step, we investigate the determinants of child nutritional status for three different quantiles, namely 0.23 (underweight) quantile corresponding to the cut-off point of -2SD, median and 0.87 quantile (overweight) corresponding to the cut-off point of +2 SD of WFA Z-scores. Table 7 shows similar effects compared to the regression for the whole sample displayed in Table 5 such as age and health of child and female headship. However, the magnitudes of the coefficients are different. Notably, the effects in quantile regression are higher than the effects in either OLS or 2SLS. Moreover, there are substantial differences in the nutrition drivers of underweight (0.23 quantile) and overweight (0.87 quantile) children. The differences are expressed in terms of the magnitude and the significance level of the coefficients of these two quantiles.

Table 7: Determinants of child nutritional outcomes by quantile regression

Dependent variable: WFA Z-scores	**Quantile**		
Independent variables	**0.23 (Underweight)**	**0.50 (Median)**	**0.87 (Overweight)**
Household wealth			
Log of per capita consumption (PPP$)	-0.01	-0.02	0.21
	(-0.08)	(-0.18)	(1.08)
Child			
Age (Years)	-1.42***	-0.97***	-1.01***
	(-3.65)	(-3.63)	(-3.25)
Age squared	0.21***	0.13***	0.12**
	(3.57)	(2.92)	(2.34)
Sick (Yes/No)	-0.78**	-0.92***	-1.13*
	(-2.30)	(-2.81)	(-1.78)
Girl (Yes/No)	0.19	-0.11	-0.29
	(1.11)	(-0.70)	(-1.31)
Mother			
Age (Years)	0.08	0.06	0.07
	(0.56)	(0.56)	(0.51)
Age squared	-0.001	-0.001	-0.001
	(-0.49)	(-0.45)	(-0.40)
Height (cm)	0.05***	0.03	0.02
	(3.32)	(1.64)	(1.53)
Education (School years)	0.004	-0.01	-0.03
	(0.19)	(-0.43)	(-0.84)

Migrated (Yes/No)	-0.14	-0.24	-0.08
	(-0.52)	(-0.94)	(-0.21)
Household			
Size	-0.06	-0.03	-0.08
	(-1.06)	(-0.61)	(-1.21)
Female headship (Yes/No)	0.58***	0.41*	0.71**
	(2.95)	(1.68)	(2.55)
Number of children under five	0.02	-0.04	-0.07
	(0.26)	(-0.59)	(-0.67)
Migration of other members (Days)	-0.08	-0.04	-0.074
	(-1.31)	(-0.73)	(-0.93)
Flush toilet (Yes/No)	0.20	0.54*	-0.22
	(0.61)	(1.84)	(-0.58)
Tap water (Yes/No)	0.40*	0.25	-0.14
	(1.74)	(1.13)	(-0.61)
Village			
Distance to town (km)	0.01	-0.001	-0.01
	(0.79)	(-0.23)	(-0.80)
Public sanitation (Yes/No)	-0.37	-0.36	0.15
	(-0.66)	(-0.71)	(0.28)
Public water (Yes/No)	0.05	-0.14	0.04
	(0.27)	(-0.77)	(0.14)
Mountainous (Yes/No)	-0.13	-0.12	0.41
	(-0.57)	(-0.45)	(0.97)
Province dummies			
Ubon Ratchathani	1.03***	1.33***	1.36***
	(3.01)	(4.09)	(3.12)
Savannakhet	0.67*	1.44***	2.29***
	(1.94)	(3.98)	(5.48)
Intercept	-8.94***	-4.75*	-2.79
	(-3.25)	(-1.75)	(-0.71)
N[a]	901	901	901
Pseudo R-squared	0.09	0.08	0.12

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in parentheses, [a]only children with a complete vector of explanatory variables are included in the regression

Source: Own calculations based on household survey 2011, 2013, 2014

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in parentheses, [a] only 901 children with a complete vector of explanatory variables are included into the regression

Source: Own calculations based on household survey 2011, 2013, 2014

Results from Table 7 additionally point out that the height of the mother is relevant only in the underweight group. Table 7 also reveals some determinants, which were not detected in Table 5. They are the sanitation facilities and the access to tap water which positively affect child nutritional outcomes. This finding is in line with the results for the rural area of South Asia in the

study of Smith et al. (2005). However, the significant effects are only found in lower quantile in the case of tap water and at the median in the case of flush toilet.

In summary, the OLS, 2SLS and quantile regressions show that nutritional outcomes of children under five in Thailand, Lao PDR and Vietnam are mainly determined by the child health condition, female headship, mother's nutritional status, and household's access to clean water.

6. Conclusions

Using a comprehensive household panel data from three provinces in Thailand, Lao PDR and Vietnam we examine whether a decline in monetary poverty automatically results in malnutrition reduction in children below five years. We also investigate the peri-urban and rural differences in poverty and malnutrition alleviation.

As expected Ubon Ratchathani in Thailand with higher per capita income tends to have less malnutrition than Savannakhet in Lao PDR and Thua Thien Hue in Vietnam. However, child nutrition remains a problem despite achievements in poverty mitigation in all these provinces. Especially, stunting is hugely prevalent in these provinces. Also noticeable is that undernutrition categorized as severe is high in the study areas.

Another result is that Ubon Ratchathani is quite homogenous both in terms of monetary poverty and undernutrition. On the contrary, Savannakhet and Thua Thien Hue are heterogeneous between the peri-urban and rural areas. The heterogeneity in monetary poverty is larger than in undernutrition. Specifically, the rural areas in these two provinces are doing worse than the peri-urban area in improving the underweight of children and particularly in reducing monetary poverty.

A key insight is that the monetary wealth only plays a role in the nutritional outcomes of children in peri-urban areas.. However child health and female headship drive child nutritional outcomes in both peri-urban and rural areas. Furthermore, social and extended family networks play a critical role in childcare in peri-urban settings. In the rural areas mother`s nutritional outcomes largely determine child health. Moreover, we also find that unhealthy domestic sanitation conditions and lack of access to clean drinking water increase the prevalence of children being underweight.

Overall, our findings show that success in reducing monetary poverty does not necessarily lead to the same degree of success in reducing nutrition poverty. To improve nutrition, other measures are necessary such as improving child health care facilities and household sanitation. Moreover, awareness needs be created to involve female members in intra household decision making in favor for child nutrition. Furthermore, the rural and peri-urban nutritional gaps need to be bridged. However, different strategies should be adopted to improve peri-urban and rural child nutrition. Cost-effective childcare services should to be established in peri-urban areas and schemes need to be developed to improve nutritional outcomes of rural girls and women.

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APPENDICES

Table A1: Determinants of child nutritional outcomes by OLS and 2SLS regression

Dependent variable: ZFA Z-scores	All		Ubon Ratchathani		Savannakhet		Thua Thien Hue	
Independent variables	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
Household wealth								
Log of per capita consumption (PPP$)	0.48**	-0.87*	0.99**	-2.54	-0.24	-2.18***	1.24***	2.40***
	(2.36)	(-1.80)	(2.39)	(-1.01)	(-0.63)	(-2.88)	(3.41)	(3.49)
Child								
Age (Years)	-2.28***	-2.29***	-1.72***	-2.06***	-2.47***	-2.27***	-2.25***	-2.25***
	(-6.01)	(-6.02)	(-2.84)	(-2.84)	(-3.81)	(-3.53)	(-3.93)	(-3.95)
Age squared	0.36***	0.37***	0.28***	0.33***	0.42***	0.40***	0.32***	0.32***
	(6.04)	(6.04)	(2.76)	(2.76)	(4.15)	(3.93)	(3.47)	(3.50)
Girl (Yes/No)	-0.32	-0.31	-0.67	-1.01*	0.00	-0.03	-0.62	-0.73*
	(-1.31)	(-1.24)	(-1.38)	(-1.88)	(0.01)	(-0.08)	(-1.64)	(-1.94)
Mother								
Age (Years)	-0.07	-0.06	0.13	0.02	-0.03	-0.07	-0.70**	-0.82***
	(-0.45)	(-0.37)	(0.44)	(0.05)	(-0.15)	(-0.29)	(-2.46)	(-2.77)
Age squared	0.00	0.00	-0.00	0.00	0.00	0.00	0.01**	0.01***
	(0.60)	(0.53)	(-0.24)	(0.19)	(0.22)	(0.28)	(2.41)	(2.72)
BMI	0.09**	0.11***	0.09	0.07	0.13*	0.18***	-0.01	-0.02
	(2.31)	(2.84)	(1.58)	(1.18)	(1.88)	(2.67)	(-0.16)	(-0.29)
Education (School years)	-0.00	0.04	0.01	0.10	0.02	0.10	-0.07	-0.09*
	(-0.04)	(1.25)	(0.24)	(1.16)	(0.28)	(1.38)	(-1.22)	(-1.68)
Migrated (Yes/No)	0.13	-0.02	-0.02	-0.14	-0.50	-0.64	-0.17	-0.16
	(0.30)	(-0.06)	(-0.03)	(-0.19)	(-0.43)	(-0.50)	(-0.32)	(-0.32)
Household								
Size	0.05	-0.04	0.12	-0.37	0.08	0.01	-0.22	-0.15
	(0.60)	(-0.44)	(0.64)	(-0.93)	(0.91)	(0.10)	(-1.40)	(-0.98)
Female headship (Yes/No)	0.22	0.35	0.19	0.51	0.35	0.79	0.30	0.62
	(0.66)	(1.02)	(0.41)	(0.93)	(0.44)	(1.01)	(0.45)	(0.94)
Number of children under five	0.15	0.09	-0.01	-0.02	0.19	0.13	-0.12	-0.03
	(1.32)	(0.80)	(-0.03)	(-0.07)	(1.28)	(0.82)	(-0.58)	(-0.17)

Migration of other members (Days)	0.03	0.08	0.14	0.15	0.06	0.12	-0.22*	-0.26*
	(0.34)	(0.87)	(0.91)	(0.89)	(0.32)	(0.64)	(-1.66)	(-1.95)
Flush toilet (Yes/No)	0.14	0.71*	-1.04	0.12	2.18**	2.48**	-0.54	-0.98**
	(0.36)	(1.71)	(-1.11)	(0.09)	(2.33)	(2.56)	(-1.20)	(-2.01)
Tap water (Yes/No)	0.05	0.42	0.57	0.58	-0.81	0.28	0.38	0.23
	(0.19)	(1.35)	(1.16)	(1.07)	(-1.33)	(0.38)	(0.84)	(0.50)
Village								
Distance to town (km)	0.00	-0.00	0.00	0.00	-0.00	-0.00	0.00	0.01
	(0.15)	(-0.10)	(0.17)	(0.12)	(-0.23)	(-0.21)	(0.09)	(0.52)
Public sanitation (Yes/No)	0.18	0.23	0.04	0.65	0.00	0.00	0.24	0.46
	(0.27)	(0.33)	(0.03)	(0.48)	(.)	(.)	(0.32)	(0.61)
Public water (Yes/No)	0.08	0.22	-0.12	-0.70	0.24	0.69	-0.30	-0.34
	(0.29)	(0.75)	(-0.11)	(-0.53)	(0.49)	(1.39)	(-0.63)	(-0.76)
Mountainous (Yes/No)	-0.12	-0.41	-1.14	-0.75	-0.12	-0.80	0.91	0.89
	(-0.33)	(-1.02)	(-1.05)	(-0.61)	(-0.14)	(-0.88)	(1.47)	(1.52)
Province dummies								
Ubon Ratchathani	0.89*	1.53***						
	(1.92)	(2.92)						
Savannakhet	-0.11	0.17						
	(-0.24)	(0.35)						
Others								
Year 2013			0.27	0.72	-1.14***	-1.84***	-1.05**	-1.35***
			(0.47)	(1.08)	(-2.73)	(-3.61)	(-2.28)	(-2.87)
Ethnic minorities							-1.51*	-0.83
							(-1.93)	(-1.05)
Intercept	-4.07	0.94	-10.19**	10.87	-2.44	5.06	9.55*	6.16
	(-1.62)	(0.29)	(-2.01)	(0.66)	(-0.58)	(0.91)	(1.87)	(1.18)
N	901	900	241	240	408	408	252	252
R-squared	0.10	0.03	0.11	.	0.09	0.03	0.21	0.18
Hausman test	p=0.00		p=0.08		p=0.00		p=0.05	

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in parentheses, [a] only 901 children with a complete vector of explanatory variables are included into the regression

Source: Own calculations based on household survey 2011, 2013, 2014

Table A2: Determinants of child nutritional outcomes in peri-urban and rural areas

Dependent variable: HFA Z-scores	Peri-urban		Rural	
Independent variables	**OLS**	**2SLS**	**OLS**	**2SLS**
Household wealth				
Log of per capita consumption (PPP$)	0.73*	1.215	0.201	-2.574***
	(1.90)	(1.59)	(0.52)	(-2.84)
Child				
Age (Years)	-1.86***	-1.767***	-2.611***	-2.287***
	(-2.70)	(-2.69)	(-3.70)	(-3.09)
Age squared	0.287***	0.272***	0.427***	0.386***
	(2.60)	(2.58)	(3.87)	(3.35)
Girl (Yes/No)	-0.282	-0.301	-0.104	-0.117
	(-0.64)	(-0.70)	(-0.24)	(-0.25)
Mother				
Age (Years)	-0.567*	-0.639**	0.028	0.045
	(-1.79)	(-1.99)	(0.12)	(0.18)
Age squared	0.008*	0.010**	-0.000	-0.001
	(1.86)	(2.04)	(-0.06)	(-0.22)
BMI	-0.039	-0.047	0.135*	0.221***
	(-0.42)	(-0.54)	(1.74)	(2.71)
Education (School years)	-0.059	-0.073	0.039	0.127
	(-0.88)	(-1.17)	(0.51)	(1.62)
Migrated (Yes/No)	-0.711	-0.620	0.432	0.363
	(-0.95)	(-0.85)	(0.67)	(0.45)
Household				
Size	-0.042	0.009	0.076	-0.009
	(-0.26)	(0.06)	(0.72)	(-0.08)
Female headship (Yes/No)	-0.202	-0.185	1.166	1.764*
	(-0.26)	(-0.25)	(1.16)	(1.73)
Number of children under five	-0.181	-0.192	0.104	0.021
	(-0.85)	(-0.94)	(0.65)	(0.12)
Migration of other members (Days)	-0.096	-0.125	0.007	0.133
	(-0.57)	(-0.73)	(0.04)	(0.63)
Flush toilet (Yes/No)	0.136	-0.025	1.372	2.767**
	(0.26)	(-0.05)	(1.42)	(2.37)
Tap water (Yes/No)	0.170	0.047	-1.340**	0.187
	(0.33)	(0.09)	(-2.29)	(0.24)
Village				
Distance to town (km)	-0.011	-0.012	-0.004	-0.001
	(-0.55)	(-0.61)	(-0.38)	(-0.07)
Public sanitation (Yes/No)	0.177	0.225	-	-
	(0.24)	(0.32)		
Public water (Yes/No)	0.655	0.689*	0.348	1.081*
	(1.59)	(1.73)	(0.60)	(1.79)
Mountainous (Yes/No)	0.821	0.822	0.194	-0.709
	(0.76)	(0.82)	(0.22)	(-0.74)

Province dummy				
Savannakhet	-0.136	-0.247	0.396	0.755
	(-0.19)	(-0.34)	(0.34)	(0.64)
Intercept	7.066	6.156	-5.486	2.838
	(1.38)	(1.24)	(-1.26)	(0.47)
N	229	229	431	431
R-squared	0.10	0.10	0.09	0.07
Hausman test	p=0.51		p=0.00	

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in parentheses, [a] only 901 children with a complete vector of explanatory variables are included into the regression

Source: Own calculations based on household survey 2011, 2013, 2014

Table A3: Determinants of child nutritional outcomes by quantile regression

Dependent variable: HFA Z-scores	Quantile		
Independent variables	**0.50 (Median)**	**0.53 (Short)**	**0.87 (Tall)**
Household wealth			
Log of per capita consumption (PPP$)	0.397	0.300	0.397
	(1.45)	(1.02)	(1.45)
Child			
Age (Years)	-2.479***	-2.484***	-2.479***
	(-6.25)	(-6.83)	(-6.25)
Age squared	0.408***	0.408***	0.408***
	(6.11)	(6.83)	(6.11)
Girl (Yes/No)	-0.300	-0.269	-0.300
	(-1.00)	(-1.11)	(-1.00)
Mother			
Age (Years)	0.136	0.126	0.136
	(0.78)	(0.91)	(0.78)
Age squared	-0.002	-0.002	-0.002
	(-0.72)	(-0.86)	(-0.72)
BMI	0.104***	0.121***	0.104***
	(2.91)	(2.97)	(2.91)
Education (School years)	0.009	0.012	0.009
	(0.25)	(0.27)	(0.25)
Migrated (Yes/No)	-0.345	-0.401	-0.345
	(-0.72)	(-0.86)	(-0.72)
Household			
Size	0.016	0.027	0.016
	(0.17)	(0.28)	(0.17)
Female headship (Yes/No)	-0.058	-0.011	-0.058
	(-0.16)	(-0.03)	(-0.16)
Number of children under five	0.023	0.011	0.023
	(0.16)	(0.09)	(0.16)
Migration of other members (Days)	0.145	0.137*	0.145
	(1.47)	(1.77)	(1.47)
Flush toilet (Yes/No)	0.059	0.062	0.059
	(0.16)	(0.13)	(0.16)
Tap water (Yes/No)	0.141	0.198	0.141
	(0.45)	(0.64)	(0.45)
Village			
Distance to town (km)	0.005	0.008	0.005
	(0.58)	(0.98)	(0.58)
Public sanitation (Yes/No)	0.584	0.506	0.584
	(0.82)	(0.76)	(0.82)
Public water (Yes/No)	0.158	0.151	0.158
	(0.56)	(0.51)	(0.56)
Mountainous (Yes/No)	-0.036	-0.063	-0.036

	(-0.10)	(-0.15)	(-0.10)
Province dummy			
Ubon Ratchathani	0.875*	0.975*	0.875*
	(1.87)	(1.67)	(1.87)
Savannakhet	-0.116	-0.130	-0.116
	(-0.20)	(-0.21)	(-0.20)
Intercept	-6.673**	-6.385**	-6.673**
	(-2.30)	(-2.45)	(-2.30)
N	901	901	901
Pseudo R-squared	0.071	0.064	0.067

Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, t statistics in parentheses, [a] only 901 children with a complete vector of explanatory variables are included into the regression

Source: Own calculations based on household survey 2011, 2013, 2014